U.S. Department
ofTransportation

Operational Strategies for Rural Transportation

March 1996

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Prepared by
ARC Transit

Florida
Coordinated
Transportation
System

Operational Strategies for Rural Transportation

Ride Solution
310 South Tenth Street
Palatka, Florida 32177

EXECUTIVE OVERVIEW

ARC Transit's AVL (Automatic Vehicle Location) project was funded by the Florida Department of Transportation in May of 1994 with $40,937 in state Service Development funds. Fourteen vehicle modules, the AVL base station, and several vehicle radios were purchased with the grant. Management Analysts, of Ormond Beach, Florida was the contractor, with Hyperdyne of Alexandria, Virginia and Canyon Development of Tucson, Arizona subcontracted to Management Analysts.

The system consists of an onboard credit card reader, digital odometer, Global Positioning Satellite (GPS) receiver, and radio interface. Data is transmitted from the vehicle's radio to the transportation system's base station where it is received by the base PC 486 computer. Voice and data share the same channel.

In Florida, Medicaid recipients are issued a plastic identification card. This card is swiped by the driver at the time that the Medicaid passenger boards and exits the vehicle. As a result, time, passenger identification number, vehicle number, latitude, longitude, and odometer reading are transmitted to the base computer. These data elements are then automatically collated in the billing computer with trip records, manually edited, and then transmitted on-line to Medicaid's fiscal agent.

Real time position of the vehicle, for the use of dispatch, is acquired by the base station's automated polling of the vehicle roster. Every three seconds the base computer and radio query the next vehicle on the roster to determine its location. In response, time, vehicle number, latitude, longitude, and odometer reading are transmitted from the vehicle to the base computer and map displayed on the monitor.

Development of the system remained in the test phase through August of 1995. All project test objectives were met and as of September, 1995, the system is being phased into operational use. The technology of this system can be a major factor in the elimination of both passenger and provider fraud, assuming a 10% rate of fraud. Projected savings in the State of Florida for one year would exceed 11 million dollars - over and above the cost of the system. The improvement in data and its immediate availability would be only one of the added benefits of the system.

The GPS/cardreader makes it possible to monitor the duplication of vehicle time and mileage within a system. This level of duplication relates directly to the efficiency of passenger loading.

Cost allocation, by allowing for the correction of a system's performance figures to a standard m.p.h., enables comparisons between urban and rural and between service formats. It is possible then to state accurately what a given time and mileage should cost.

If we know that we have achieved the highest possible passenger loadings in conjunction with the lowest possible vehicle costs, we know that the service delivery system is at peak efficiency. We know that we have achieved Coordination.

The RIDE SOLUTION
Managing Growth while Reducing Costs

Developed strategies for fixed route with deviation (FRWD) transportation.

Methodology and software for the accurate costing of transportation.
Analytical methods and software for the identification of viable route corridors.
Vehicle procurement and break even analysis based on FRWD strategies.
Reservation and billing software to support FRWD service format.
Driver information and reporting systems to support more complex schedule development.
Real time AVL technology for dispatch monitoring of vehicle location and on time performance.
Mixed loading of agency passengers. Up to five agencies on one bus at one time.

Promoted community involvement

Organized routes to serve multiple groups.
Distributed overhead costs by route or service.

Designed fixed "large bus" routes with variable side routes

Avoided costly single-rider service wherever possible.
Maintained schedules so the community could rely on Ride Solution buses.
Purchased used buses as demand grew (from 2 to 25 buses in 10 years).

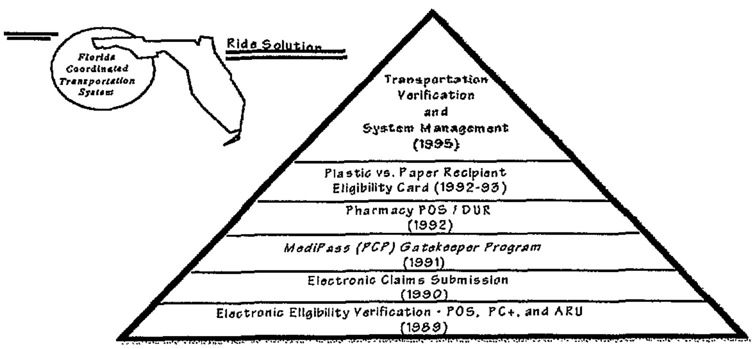
Created a fully integrated data collection and information management system.

One employee scheduled all rides (170,000 per year) for the County.
Coordinated many vendors in creating the overall system.
Managed cashflow efficiently in a $1 million dollar budget.
Controlled fraud using verification and automated controls.

Planned additions

Create an automated Medicaid ride request system.
Create GIS/GPS-based software for the detection of duplicated vehicle time and mileage.

Access of Florida Medicaid Data By Healthcare ***and Transportation*** Providers



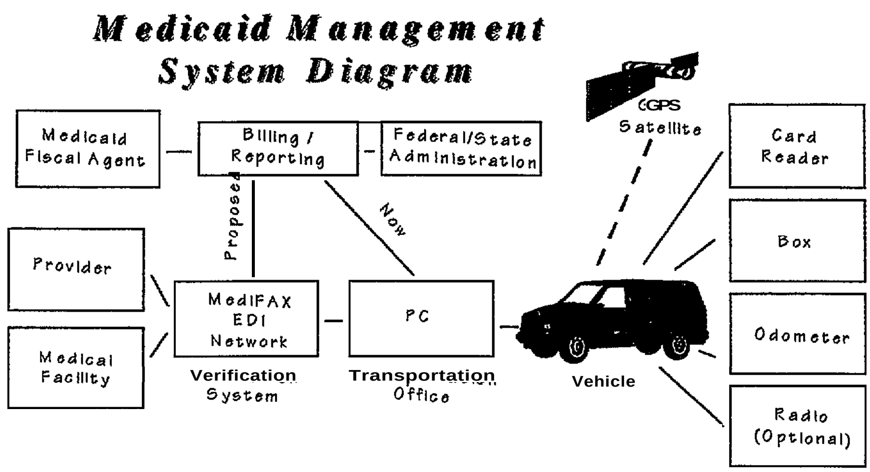
MediFAX(R) Eligibility Is The Foundation

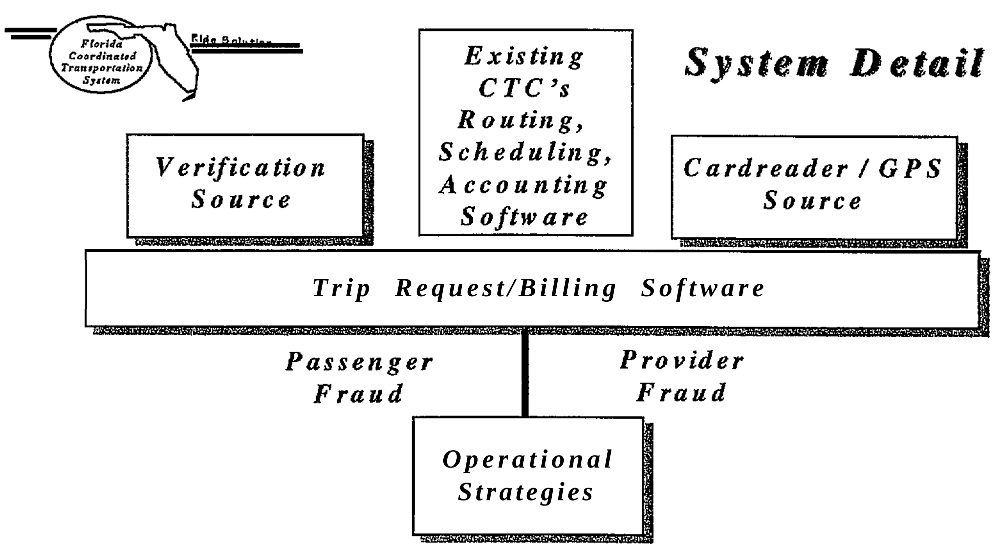
ADVANCED TECHNOLOGY YIELDS NEW STRATEGIES

In order for Florida Medicaid to manage its transportation funding during a period of decreasing allocations and increasing fraud, a cohesive administrative methodology is needed to provide a clear audit trail from the point of trip request to the point of trip delivery. To establish this trail, Florida Medicaid needs to be assured of four points of control:

1. The trip request must be authentic.
2. The trip requested must be as short as possible.
3. The trip provision must involve the lowest possible vehicle costs.
4. The trip provision must involve the highest possible passenger loadings.

Cost effective instrumentation at the points of trip request and trip delivery provides the answer.





MEDICAID MANAGEMENT SYSTEM DIAGRAM

PROVIDER + MEDICAL FACILITY

Most medical providers and facilities use either point of sale machines or computer software to verify Medicaid client eligibility via an eligibility verification service such as The Potomac Group's MediFAX(R) network. The origination of the trip request by medical staff vastly improves the probability of an authentic trip request. Point of sale machines can be programmed to present ride request menus after the card pull.

MEDIFAX(R) ED1 NETWORK VERIFICATION SYSTEM

Insertion of a GIS database into this step of the trip request provides the opportunity to reschedule the trip if there are closer appropriate medical facilities-

PC TRANSPORTATION OFFICE

Trip requests are transmitted directly to transportation provider's computer from the Medical Service Provider via the Verification Source, eliminating manual data input, errors in client/reservationist communication, and vastly reducing the phone load. Trip requests are processed and given to drivers.

VEHICLE

A vehicle equipped with cardreader, Avtrax box, digital odometer, and radio (optional) is an extraordinarily difficult device with which to commit fraud. Every time the cardreader is swiped with a Florida Medicaid card, client i.d. number, date, time, latitude, longitude, vehicle i.d. number, and odometer reading are captured. Point of pickup, point of drop off and the route taken in between are fully revealed. A GIS plot of vehicle movement with software detection of duplicated time and mileage will assure that the route taken was as direct as possible and that multiloading was as high as possible.

BILLING/REPORTING

Billing of authentic Passenger trip data against authentic trip requests eliminates payment for fraudulent trips. Reconciling trip requests against trips provided occurs within the verification system's reservation/billing module.

MEDICAID FISCAL AGENT

Billing can be transmitted by the verification system network to the Medicaid fiscal agent.

FEDERAL AND STATE ADMINISTRATION

Reporting can be transmitted by the verification system network to the Medicaid state or federal offices.

SYSTEM DETAIL

The insertion of the trip request/billing software underneath the existing CTC's (transportation operator's) routing, scheduling, and accounting software eliminates the need to arrive at standardized modules for these areas before a substantive statewide management information system can be put in place. Verification source provides authentic trip requests. Onboard cardreader/GPS provides authentic trip data.

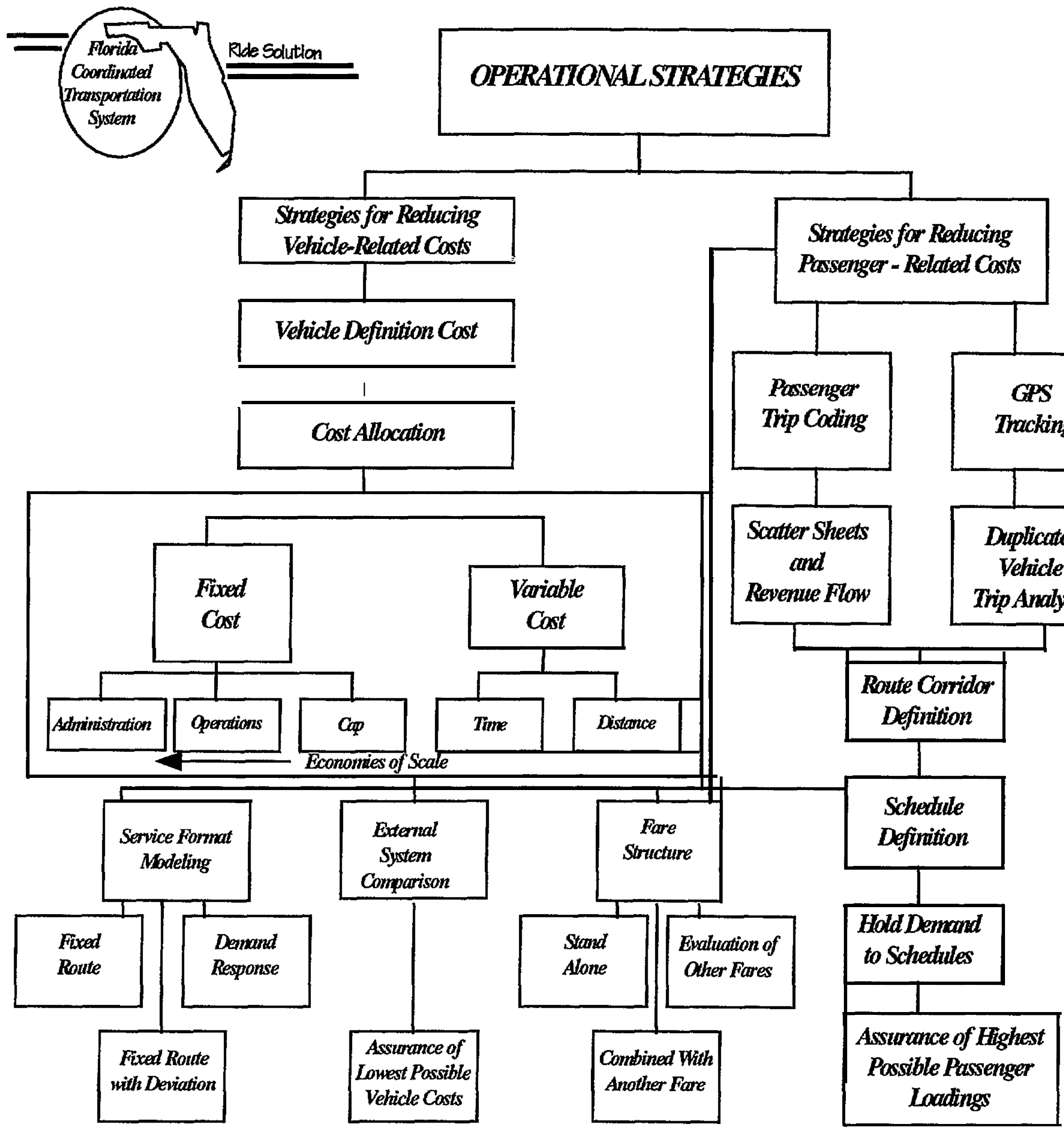
The elimination of passenger and provider fraud provides the funding to implement this technology. The level of Medicaid fraud determines the level of funding that can be put towards this implementation. Last year, $925,233.00 in Medicaid transportation funding flowed through the 26 vehicles transporting Medicaid passengers in Putnam County. If the statewide level of fraud and clerical errors was 10%, then each vehicle in Putnam County represents $3,558.00 in wasted funding. The onboard GPS/cardreader equipment installed in our vehicles cost approximately $1,600.00. Prorating this equipment over only a three year warranty period yields $533.00 per year or only 14% of the projected fraud. This results in a net savings of $3,025.00 per vehicle per year. If this level of Medicaid savings held true for all of the 3788 paratransit vehicles operated in Florida during 1994, projected Medicaid net savings would amount to $11,458,700.00. These are savings above the $6,060,800.00 projected cost of equipping all of the Florida vehicles with GPS/cardreaders Medicaid cannot afford to be without this technology.

OPERATIONAL STRATEGIES

The use of this technology also positions managers of all levels to improve the overall efficiency of the delivery system. For the first time, duplicated paratransit time and mileage is retrievable on an ongoing basis. This, when combined with cost allocation methods points the way towards lowest possible vehicle costs coupled with highest possible passenger loadings.

OPERATIONAL STRATEGIES

Once the trip requests are received, there are only two operational results. First, a vehicle and driver are assigned to the service. Second, passengers are assigned to the vehicle and driver. All operational strategies then relate to the objectives of assuring either the lowest possible vehicle related costs or the highest possible passenger loadings.



STRATEGIES FOR REDUCING VEHICLE-RELATED COST

Development of strategies for controlling vehicle-related cost is the first objective because this is where service begins. A vehicle and driver are necessary before service to passengers can be offered. Lack of control in this area will be passed through to passenger-related costs.

Vehicle Cost Definition

Accurate costing methods must be arrived at before vehicle costs can be controlled. This is as true at the state or federal levels where funding allocations are determined, as it is at the local level where the service is budgeted and delivered. There is a need for performance based allocation systems in conjunction with demographically based allocations to address issues of efficiency as well as need. In order to determine appropriate levels of funding, those responsible for allocating funds should have the same information as those who are responsible for living within those allocations. This is not micro-management. It is the same direction that the private sector has taken in the last ten or more years. As local information has become more accessible and reliable, the tasks of middle management have been absorbed by upper management.

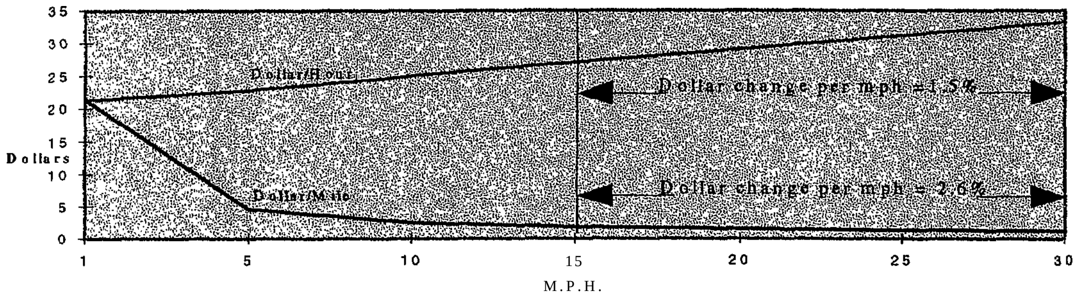
The difficulty, at this time, in transitioning to more efficient state and federal management methods for "Coordinated", rural, or community transportation, is that several of the standard performance indicators, such as cost per mile, cost per hour, and cost per passenger trip, are driven more by the average mile per hour (m.p.h.) of the delivery system than they are by the line item budget. These performance indicators may be adequate for urban (Section 9) systems where variations in m.p.h. between systems is minimal, but, in Florida, there is approximately a 15 m.p.h. total variance between F.S. 427 Coordinated systems that is not directly related to typical rural and urban classifications. Within Coordinated transportation, m.p.h. is more a function of the service format being used (i.e. fixed route, fixed route with deviation, and demand response) than a function of population density. Fixed route with deviation transportation, with relatively low m.p.h. can occur in rural settings while demand response transportation, with relatively high m.p.h. can occur in urban settings.

In our experience, using the budgeting spreadsheets developed at ARC Transit, m.p.h. drives up cost per mile at the rate of about 3% per mile per hour while cost per hour is driven inversely at the rate of about 1.5% per mile per hour, within the 15 to 30 m.p.h. range experienced by most systems. These percentages will vary somewhat based on the overall ratio of time to mile related costs, but over the 15-30 m.p.h. range it is safe to say that the cost per mile will naturally vary a total of about 45% and cost per hour about 22%. As m.p.h. increases, cost per mile decreases and cost per hour increases. This is represented by the following table and chart.

Table 1: Cost Change Due to MPH Increase

M.P.H.	*Cost Per Hour*	*Cost Per Mile*
1	$ 21.33	$ 21.33
5	$ 22.98	$ 4.60
10	$ 25.05	$ 2.50
15	$ 27.11	$ 1.81
20	$ 29.17	$ 1.46
25	$ 31.23	$ 1.25
30	$ 33.29	$ 1.11

M .P.H. Chart



At ARC Transit, services vary from a low of 5 m.p.h. for a wheelchair route with seven subscription passengers to a high of 28 m.p.h. for an all ambulatory route with ten subscription passengers. Fully allocated cost per mile - cost per hour for the two routes is $4.60 - $22.98 and $1.12 - $32.50 respectively, using the same personnel and vehicles. The limitations of using cost per mile or cost per hour in the budgeting or allocation process are, then, as follows:

1. Both of these performance indicators are too responsive to fluctuations in m.p.h. to be of benefit in making accurate comparisons between systems that vary significantly in m.p.h. or budgeting for a system that is experiencing significant flux in total system m.p.h.

2. Cost per hour, while appearing more stable and accurate than cost per mile, is actually less when it is considered that a one percent error in defining cost per hour equates to a twenty percent error in cost per mile in a twenty m.p.h. system. Cost per hour is more gross an indicator than cost per mile by a factor equal to the average m.p.h. of the system being evaluated.

3. The effects of m.p.h. on cost per mile and cost per hour are passed on to cost per passenger trip, which is also itself driven by the influences of average passenger trip length and average passengers per vehicle mile. Of the three indicators, cost per passenger trip has the most number of influencing variables that must be corrected if cross-system comparisons are to be made.

4. Once the data is rolled up into cost per mile, per hour, or per passenger trip it is usually impossible to correct for the influences of those outside variables unless the reporting systems have been specifically designed to acknowledge them.

Cost Allocation

The first distinction to be made in cost allocation is to distinguish fixed and variable costs. Transportation, like any other production environment, is a race to produce as many units of service against overhead as possible. Economies of scale are the first line of defense against rising transportation costs. It is essential in evaluating the efficiency of a system to know how much of the funding available is reaching the street.

Fixed costs, which are accrued on a monthly or annual basis and do not vary directly with the operation of the vehicles, divide naturally into Administration, Operations, and Capital cost centers. If the ratio of Fixed to Variable costs appears, by comparison with other systems, to be high, the first check becomes an individual comparison of these three cost centers against other systems.

If the ratio between Fixed and Variable costs appears normal, it still must be confirmed that both are not similarly inflated. This is the same check that is made if the ratio between Fixed and Variable is abnormally low. The anchor for the analysis is a clear audit trail of what vehicle Time and Distance is being provided and a direct line item relationship between driver salaries and vehicle Time and vehicle expendables (fuel, oil, tires, maintenance) and vehicle Distance. These cost centers can then be corrected by cost of living index figures to provide cost per vehicle hour (in terms of driver salaries) and cost per vehicle mile (in terms of vehicle expendables) that are directly comparable to other systems.

A final refinement of the analysis is made, for the purpose of external system comparison, by correcting the Time and Distance cost centers to a standardized m.p.h. Mile per hour again becomes an influence when Time and Distance costs are rolled together into Variable costs. This correction to a m.p.h. standard is made by the following formula:

$$\frac{\textbf{Standard M.P.H.}}{\textbf{System M.P.H.}} \times \textbf{System Miles} = \textbf{Standard Miles}$$

Given standard miles and the system's cost per mile in terms of vehicle expendables, the miles cost center is corrected to reflect standard miles by multiplying standard miles by the systems cost per mile. This then corrects the fixed/variable ratio to a standard m.p.h. and allows for accurate economies of scale comparisons between systems.

External System Comparison

This analysis is easier to do than it is to explain. Once the reporting structure is keyed to these cost centers and supported by software, the analysis is automatic and is actually performed inverse of the explanation with correction to **standard** miles occurring first. By factoring in cost of living index and correcting for m.p.h., it is possible to state with accuracy what the allocation to a system should be, based on the time and mileage it is incurring. It remains then to be determined if that time and mileage has been incurred efficiently.

Assurance of Comparable Vehicle Costs

Once vehicle costs are comparable, funding sources are positioned to allocate, (based on acceptable vehicle time and mileage costs) in terms of unduplicated vehicle time and mileage. When dealing with non-fixed route systems, funding source detection of unduplicated time and mileage involves the use of Geographic Information Systems/Global Positioning Satellite (GIS/GPS) to sample the system. Performance-based allocations can then be made. Engaging the profit motive by the use of a capitation system ensures that system time and mileage will be minimized by the system operator.

Service Format Modeling

A cost allocation spreadsheet, when combined with passenger and revenue flow studies, is the basic tool that system operators need in order to minimize vehicle time and mileage. The system operator must be able to distinguish which of the three service formats (fixed route-fixed route with deviation, or demand response) are most cost effective for a given environment. For example, if the operator knows what time, mileage and revenue are generated by the demand response traffic along a certain route corridor, then the operator is able to, with a cost allocation spreadsheet, determine what headways can be provided along the corridor with the fixed route with deviation service format. The distinction between these three formats, then, is the level of headway that can be achieved with the revenue already in place.

Fare Structure

In areas that are not funded by a capitation system but rather by derivations of cost per mile, cost per hour, or cost per passenger trip methods, cost allocation can be used to strike a base line against which other fare methods can be evaluated. This is useful for the system operator in either bid evaluation or evaluation of in-house service. It is also useful for the funding source in evaluating the rates that are being used by the operator. Cost allocation can further be used as a stand alone fare structure where service is sold by the vehicle trip, such as subscription and charter service. In areas where vehicle data is easily acquired via onboard cardreader/GPS equipment, cost allocation can be combined with another fare method to create a running bid where the funding source pays the lower of the two fares during a given period of time. This requires a high level of onboard, ongoing automation, exceeding that of the capitation per GIS/GPS sampling approach, but if human service transportation adopts the GPS/cardreader as business in general has adopted the fax machine, the potential is there.

STRATEGIES FOR REDUCING PASSENGER-RELATED COSTS

Once the lowest possible vehicle costs have been defined, strategies for achieving the highest possible passenger loadings begin. At ARC Transit these strategies are driven by two parallel data collection methods; passenger trip coding and GPS tracking.

Passenger Trip Coding

The oldest method, which has been in place for the last nine years and was used in 1988 to design Putnam County's route system as it exists today, involves the automatic coding of passenger pickups and destinations via the reservation system. For example, a passenger trip beginning in Palatka, Putnam County (PP) with a destination in Gainesville, Alachua County (GA) would have a pickup/destination code of PPGA. With the integration of the reservation and billing systems, passenger trips and revenue flow between coded population centers can be analyzed.

Scatter Sheets and Revenue Flow Analysis

In order to determine where potential route corridors exist, passenger trip scatter sheets and revenue flow studies are created from various combinations of pickup/destination codes driven by data from the reservation and billing modules. The scatter sheets display passenger trip frequency over both daily and monthly periods along a given corridor. Revenue flow studies not only summate monthly trips and revenue along corridors but also itemize trips and revenue by pickup/ destination codes existing within those corridors.

Route Corridor Definition

When transitioning from demand response to fixed route with deviation service formats, a viable route corridor exists when demand response and subscription revenues are high enough to support reasonable headways. The break even point in this analysis is arrived at through cost allocation service format modeling.

Transitioning from fixed route to fixed route with deviation service is considered when route revenues and subsidy are no longer adequate to fund the fixed route. The analytical process is the same but requires the melding of fixed route and paratransit data. Paratransit funding sources should be viewed by fixed route systems as a resource, particularly when faced with declining ridership or subsidy.

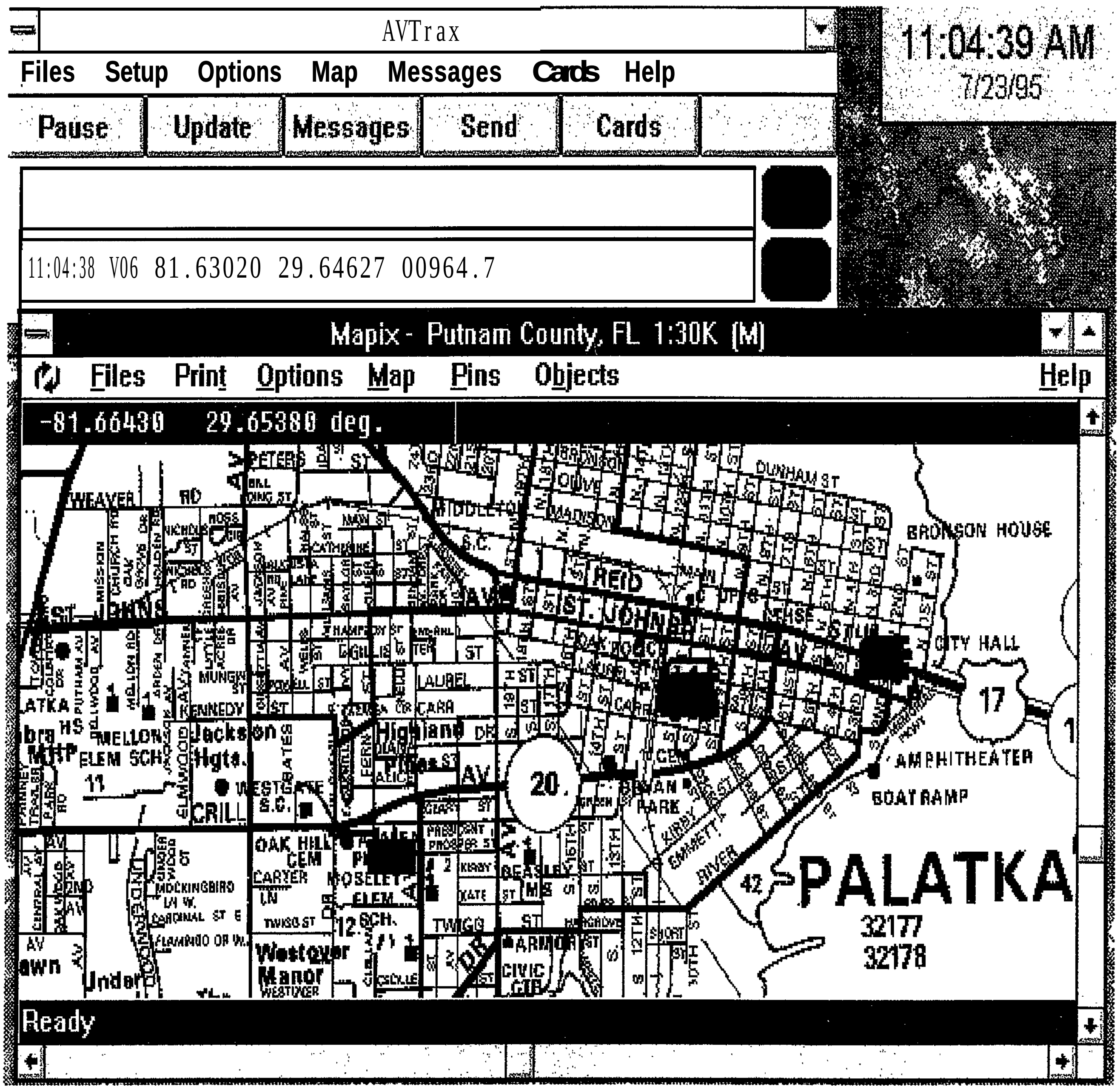
Schedule Definition

Once a viable route corridor is defined, scatter sheets can be used to correspond the headways with demand peaks. Again, cost allocation spreadsheets are essential to "what if" the data.

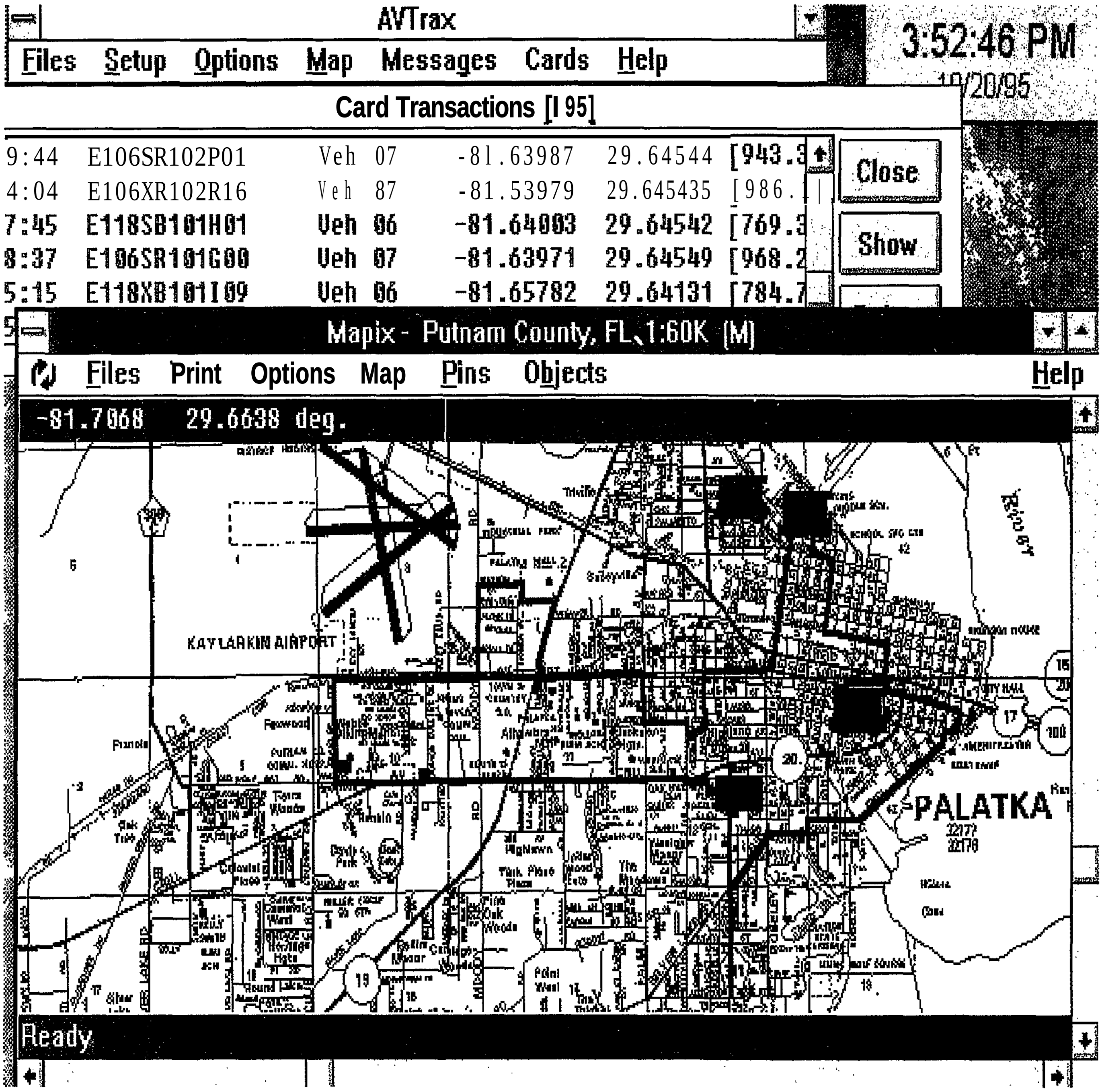
GPS Tracking

The following monitor screens illustrate the use of GPS tracking to provide real time information and data useful for immediate dispatching, billing and analytical purposes:

1. AVTRAX, the GPS program, is windowed over Mapix, the mapping program. The AVTRAX window is displaying on the MAP bar, the time, vehicle number, latitude, longitude and odometer reading of vehicle number 6 as seen in the Mapix window. Dispatch personnel have the actual current location of all vehicles within radio range available at a glance. (See Screen Below)

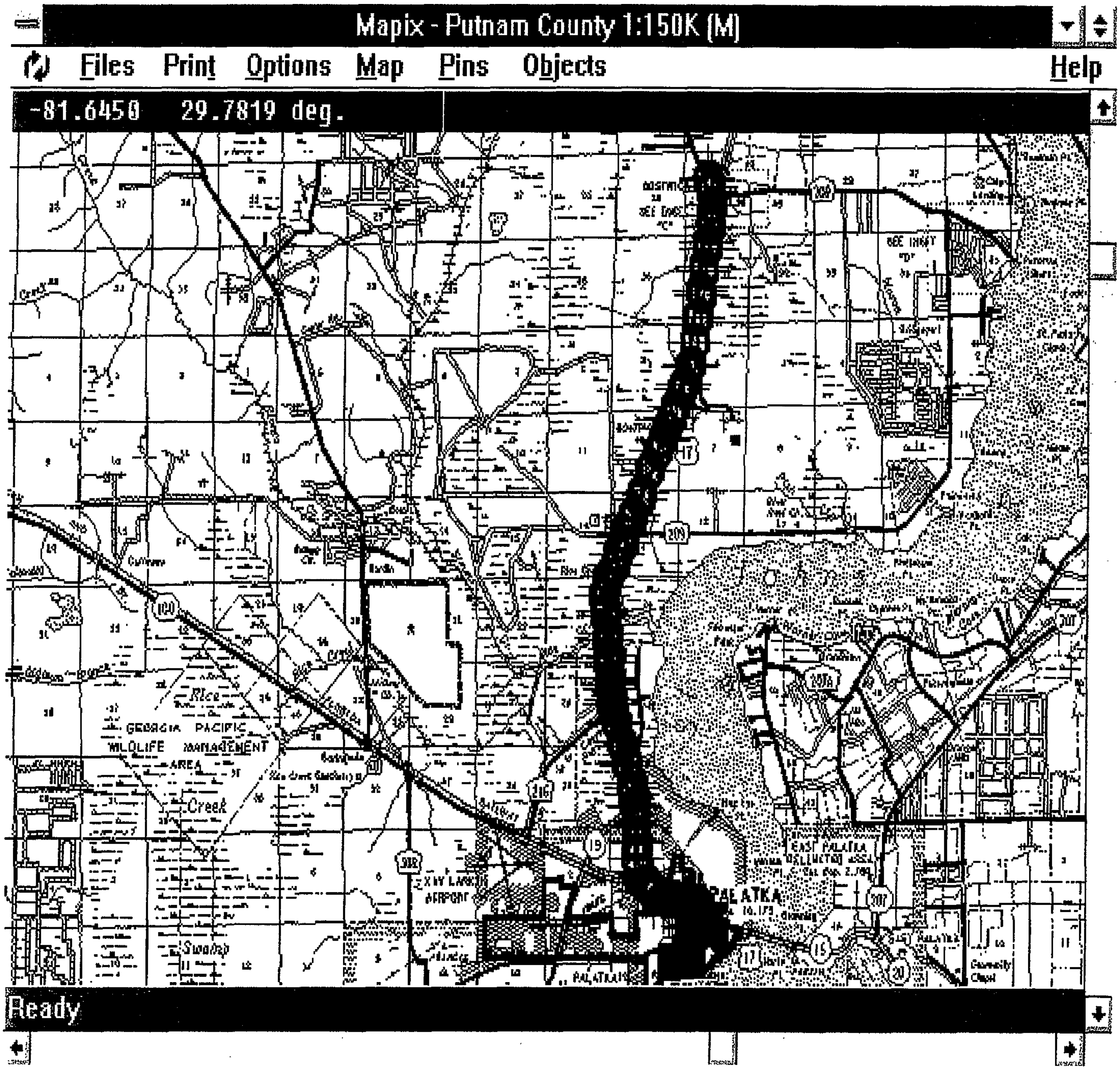


2. AVTRAX is windowed over Mapix with the AVTRAX card file also displayed. The card file includes the card pull data on all drivers and Medicaid passengers entering or exiting the vehicle. Each card swipe gives time, driver or passenger i.d. number, vehicle number, latitude, longitude, and odometer reading. Card data is saved to a file for later use in billing and reporting. {See Screen Below)



3. Mapix window has been maximized and the Vehicle Track function enabled to graph vehicle movement. GPS data is essential if the management of human service transportation funding is to move to a higher level of efficiency. In the face of inevitable budget cuts, higher levels of efficiency are the only alternative to service reduction. Graphic depiction of vehicle movement provides a powerful tool to analyze duplication to identify possible new route corridors. (See Screen Below)

GPS data feeds directly into definition of route corridors and schedules.



Duplicate vehicle trip analysis

The emergence of the onboard GPS/cardreader has provided the opportunity for graphic analysis of human service transportation systems. It is now financially feasible to plot the exact movement of all vehicles throughout a system during a given time period. If parameters for duplicate vehicle time and mileage are established, then both the funding source and system manager have a very effective tool on which to base allocations, evaluate performance, and identify route corridors.

Hold Demand to Schedules

The conversion of demand response trips into fixed route with deviation schedules requires that the new service is provided with reasonable headways. Conversely, it is also required that transportation users, which include both the passengers and their destination service centers, conform their appointments to the schedules provided. In the case of Medicaid, this is not an overly burdensome task given the proliferation of point-of-sale equipment in medical facilities (Refer to System ***Diagram*** on Page 3).

In order to cap or reduce Medicaid transportation costs while providing for the growth of the Medicaid population it is necessary to leave behind the current random scheduling of this transport. To leave random scheduling in place will require reduction of service. Reduction of services to those living below the poverty level, without corresponding increases in opportunity, is not a workable option. Increases in opportunity, in the face of increasing population and diminishing resources, is a challenge that will be met only over time. Increasing the efficiency of our service delivery systems will provide the time necessary to build opportunity.

Break even analysis at ARC Transit indicates that within the fixed route with deviation vs. demand response arena, a thirty-foot bus becomes substantially more cost effective than a four door sedan on the fifth or sixth passenger. The bus vs. a raised roof, 10 passenger, lift-van becomes more effective on the eleventh passenger. We no longer consider unmodified vans or one ton van cutaways due to loading and g.v.w. problems. Buses and bus routes, under these conditions, can be more efficient than demand response service at relatively low passenger loadings. A thirty foot, twenty-nine passenger bus with only six passengers on board has just eclipsed the efficiency of a five passenger sedan. The bus is at only one-fifth capacity. This is how passenger growth can be accommodated without significantly increasing costs. Hold demand to reasonable schedules.

Assurance of Highest Possible Passenger Loadings

Assurance of comparable, and therefore lowest, vehicle costs means that economies of scale have been maximized. Assurance of highest possible passenger loadings means that duplication of effort has been minimized. These are the cornerstones of coordinated human service transportation.

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